Aalto University
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Estimating the impact of corporate income tax changes to public companies' capital structure inside European Union

Bachelor's Thesis
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Abstract

I investigate the tax sensitivity of European public companies' capital structure decisions to corporate tax changes made in their home country. The research covers all the tax changes made inside the current 28 member states during the 1980-2016 period. The research is made by using difference-in-difference model which compares the firms affected by tax change to other control groups with no tax changes. Within two years, companies lower their leverage on average by 45 basis points in case of tax decrease. Contrary to trade-off theory, long-term leverage seems to response only to tax cuts, not increases. In addition to the full sample of all firms, I also test the tax responsiveness of different control groups based on the, distress levels, location of sales, profitability and dividend payout. The tax sensitivity is greatest among profitable firms and firms with only domestic sales.

Contents

1. Introduction

This paper examines the tax sensitivity of European public companies' capital structure decisions to the corporate tax rate changes in EU member countries. I'm studying whether the firms respond to the tax cuts or increases by changing their capital structure and whether the corporations consider the tax benefit of debt in their capital structure decisions. The research is based on the same approach as Heider & Ljungqvist (2012) used in their research which was able to identify that companies do consider taxes as a first-order determinant of firms' capital structure choices in U.S.

The contribution of this paper is to empirically prove that firms do reflect on the tax changes of nominal tax rates. The experiment is done by using difference-in-difference method. The approach aims to find causal understanding of firms' capital structure decisions by comparing firms in countries with no tax changes to companies which are effected by a tax change and examines whether there are differences in the changes of their leverage ratio. I find out that companies increase their amount of debt as the rate of taxation rises in their home country.

The results are economically significant. The estimation shows that during the period 1980-2016 the firms inside EU-area decrease their long-term leverage on average by 0.22% percentage points in the same year and 0.23% before the tax cut.

The empirical results do not correspond according to the theoretical basis of capital structure decision (e.g. Modigliani & Miller, 1963) as the response on leverage to tax rate changes should be reciprocal. On contrary to the research of Heider & Ljungqvist (2012), European corporations responded only to tax cuts. Tax sensitivity is asymmetric and if the taxes increase firms do not respond by rising their leverage ratios. The results are strongest among highly profitable firms and for companies with only domestic sales.

2. Research question and hypothesis

The research question of this paper is, whether the public firms in Europe change their leverage ratios in relation to the corporate tax changes. The theoretical basis of this problem is classical. The cornerstone of the value of debt is from 1958 when Modigliani & Miller published the theorem of the value of levered firm. According to the theory the value of the firm is defined by combining the value of the equity with the value of tax shields. The tax shield consists of the product of tax rate and the value of debt

A slightly more recent publish, the trade-off theory states that companies choose how much to use debt and equity finance by balancing the costs and benefits (Kraus & Litzenberger, 1973). The two trade-offs are the tax shield benefit of leverage for the firm in contrast to the cost of financial distress. The financial distress costs consist of bankruptcy costs caused by the debt level and indirect costs like leaving staff and unfavorable payment terms. The tax shield value grows linearly whereas the costs of distress are convex and increase rapidly as certain level of leverage is reached. Figure 1a illustrates the total market value of firm with different debt levels. The optimal level of debt is reached when further increasing of debt increases the marginal cost of distress equally compared to the marginal benefit of tax shields.

In figure 1b is illustrated the ideal experiment on randomly assigned different tax rates to firms and then compared their leverage to see whether different tax rates lead to different debt policies. The ideal experiment though is not possible because there is always some unobserved firm-level heterogeneity. The marginal benefit of tax shield is not the same for every corporation; this is demonstrated in figure 1c. Even with the same nominal tax rate, effective tax rate differs depending e.g. if the firm has deferred tax assets from previous years' losses. Similarly, a high-profit firm pays relatively more taxes compared to firms with smaller income. The higher the effective tax rate is, the larger the tax benefit of debt is for the firm but the high profitability also makes the borrowing easier when the company may get loans with better terms from financial institutions.

It is challenging to identify whether the increased borrowing for high-profit firms are due to the more valuable tax shields or lower marginal cost of debt. Figure 1d visualize the case if there's no impact on leverage in occasion of tax rate changes. If the null hypothesis of no sensitivity would be wrongly rejected the observed change in leverage is caused by variances in marginal cost of debt. This problem is designed to overcome in this experiment as the diff-in-diff method takes industry and country-specific developments into account. This means that the industry-shocks and firm-heterogeneity will be taken into account and their effect are removed from the results (Heider & Ljungqvist, 2012).

In practice, firms do not reflect smoothly to the tax changes, because changing leverage ratios have remarkable costs. Companies may change their leverage ratios either by increasing their equity or by cutting down

borrowing. Obtaining new financing has always issuance costs, which consists from asymmetric information between the management and stakeholders as well as from transaction costs. The pecking order theory (Myers & Majluf, 1984) suggests that internal financing is the preferred way for the firm to finance its operations (no asymmetric information/transaction costs) followed by issuance of debt. The least favorable way to acquire financing is issuing new equity as it usually leads to a decrease in stock price.

As the interest expenses are generally tax deductible from the corporations' income in Europe, companies should react to the tax rate changes symmetrically. Lowering tax rates decreases the value of tax shields and makes equity more valuable with respect to debt. The hypothesis based on the theories is that companies should add the relative share of equity to debt in case of tax decrease. If the member states increase the taxation on companies, the firms are expected to increase their leverage to as the value of tax shields increases. The null hypothesis thus is that taxes do not have effect on leverage.

3. Data and methodology

The research data was collected from four sources. For the firm-specific data, I used the data from Thompson Reuters Datastream which covers the data for all European public companies. The data for country-wide variables were collected from the OECD's and The World Bank's databases for all available years. The data is collected and reported in U.S. dollars to make the variables comparable through time.

3.1 Firm-specific variables

My sample consists of every member countries' public companies reported in Thompson Reuters Datastream-database during the years 1980-2016. To collect the data of firms from each country, I used constituents lists which include all available companies inside the observation period. In total, there's data for 15 855 firms in 37 years. To avoid biased estimations, the sample also includes firms which do not exist in European stock exchange anymore but have been listed to some European Union's member country's stock exchange during the period. The data is collected from all available years for each member of the Union. For example, if the country became a member of European Union in 2004, the data is still collected from 1980 onwards.

Dependent variable

There are many various alternatives for the dependent variable. It's possible to use total debt of company to define the company's capital structure. However, the long-term leverage is likely to be more accurate estimate because short-term debt is strongly related to net working capital changes. Net working capital is typically non-interest bearing debt and seldom used for capital structure decisions. In the numerator of dependent variable thus is long term debt and in the denominator, the total assets of the firm. Because the book value of long-term debt cannot go over total assets by the definition, I exclude every observation which are greater than one and consider them as an error in data.

Control variables

The firm specific control variables needed for the research are total assets (Datastream code: WC02999), return on assets % (WC08326), price-to-book value ratio (PTBV), net tangible assets (NTA), total debt (WC03255) and long term leverage (WC03251). For dividend payout ratio (% earnings) I use Datastream item WC08256 and for international sales item WC07101.

I exclude all financial institutions with SIC = 6 (3952 firms, 31741 observations) and public-sector entities with SIC = 9 (13 firms, 16 observations). Financials are disregarded due to the very high leverage ratios and changing regulation during the period. Public-sector entities are not market value driven in same way as private companies, which is why they are omitted. Utility firms are also omitted from the data combining (419 firms,

1967 observations) because they require significant infrastructure and these firms often carry large amounts of debt and are highly sensitive to changes in the interest rates (e.g. Investopedia, 2017). Also, all the firms with negative or missing total assets are omitted from the research.

The home country of the firm is assumed to be located according to the IBES-country codes. There are though surprisingly many missing observations (4187 out of 15888). Not to limit observations too much, if the IBES-country code is missing from the data, I assume the stock to be from the country of the exchange. This may lead to few error estimations but it increases the amount of observations remarkably. The IBES-country code is static variable, and if a firm moves its HQ to another country during the observation period, it causes error estimations to the sample.

I include a variable that measures the size of the firm to the regression, because large-cap firms tend to be able to have better borrowing conditions as their risk of default is considered to be lower. The firm-size is defined as the natural logarithm of total assets of the firm.

The tangibility of assets is included to the regression as the bigger share of the firm's assets are tangible, the more firm can offer deposits to guarantee borrowing. Tangibility is defined by the natural logarithm of net tangible assets. This omits every observation that is below zero. Also, if the value of net tangible assets rise above total assets, the observations are omitted from the sample. Another option is to create a year-specific rank variable of the net tangible assets in relation to total assets but it creates strong correlation between the dependent and explanatory variables as likewise the long-term leverage is divided by total assets. Either way, the tangibility item seems to have a sizable and significant negative impact on long-term leverage, which seems to be against the supposition. The issue isn't smoothened by cutting out the tales by 0.5% or/and using original values of assets in USD. Similarly using same kind of annual rank values for total assets and scaling them comparable with net tangible assets doesn't change the overall picture.

The leverage might change in response to changes in corporate growth opportunities (Faccio & Zu, 2011). For that reason, I include price-to-book ratio is included in the regression to estimate different investment opportunities for the firms and its affection to leverage. In total, there are 183565 observations with a mean of over 203.3. It's clear that there are some outliers in the data which causes biases so I cut out half a per cent (915 observations) from the largest and smallest values. After the cut out, the average of the sample is 2.40.

Without profits, there's no tax benefit of debt. To estimate profitability, I use return on assets ratio. The raw data of return on assets seem to have some biases as its arithmetic mean is -16.53. To rationalize this bias in data I also remove 0.5% of the observations from the tails. After the cutting the arithmetic mean of the sample is 2.79.

Financial distress costs

Although the theoretical basis of trade-off theory has long been known, the financial distress costs for firms has been difficult to estimate empirically. Givoly, D. & Al. (1992) used Tobin's Q ratio as a proxy for the distress costs for the firms during the Tax Reform Act in 1986. Altman (1968) introduced Z-score model to estimate the failure probability and distress costs for the firms. Another way to estimate distress costs would be the corporate bond yields and corporate credit ratings. The problem with European data is that as the capital markets are not as developed as in U.S. and there's much less data available of bond yields. Either the credit rating industry is nowhere near the U.S. level in Europe so I must come up with some other proxy for distress costs. If I used only data with credit ratings/bond yields, it would limit the observations immoderately and it would lead to biases as the major of the firms with marketable corporate bonds are large-cap.

There is no any proxy for replacement costs in datastream which is required for the Tobin's Q ratio and every estimation of them are subjective guesses of the true replacement value. The Altman Z-score is the output of a credit-strength test that gauges a publicly traded manufacturing company's likelihood of bankruptcy. Initially introduced by Edward Altman (1968) the Z-score and has widely been used for distress cost estimations. A later study made by Agarwal & Taffler (2007) provides empirical evidence that Z-score has true failure prediction ability. Even if there are many restrictions using the z-score test Altman & Al. (2014) show in their study that for non-financials Z-score, the general model works reasonably well, for most countries, with prediction accuracy levels (AUC) of about 75%, and exceptionally well for some (above 90%).

With this background, I choose to use the Altman's Z-score model as the estimate for the distress costs. The Altman Z-score is based on five financial ratios that can be calculated straight from accounting data. It has a profitability, leverage, liquidity, solvency and activity measures to predict whether a company has a high degree of probability of being insolvent. High Z-score value indicates low distress costs. The formula of Altman's Z-score is:

$$\text{Z-Score} = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E$$

Where A = working capital / total assets, B = retained earnings / total assets, C = earnings before interest and tax / total assets, D = market value of equity / total liabilities, E = sales / total assets (Altman, 1968).

3.2 Country-specific variables

GDP growth and unemployment rates

The majority of country-specific variables are collected from OECD, but information is also collected from The World Bank if the nation is not a member of the organization. The country specific data consists of the annual real growth rates of gross domestic product and the unemployment percentage

Corporate Tax Rates of Member States

The data of corporation tax changes was gathered from two sources. For years 1980-2000 I used data from Trading Economics website. In time period of 2000-2016 I used tax data from OECD for the member countries. As Bulgaria, Croatia, Cyprus, Malta and Romania are not members of OECD, their data was entirely collected from Trading Economics. There is one variation between Trading Economics and OECD's data, Latvia's change between years1999-2000 are reported to decrease from 29% to 24% according to Trading Economics and from 29% to 25% according to OECD. In occasion of contradiction I chose to use data from OECD.

Every country in European Union taxes its corporations. There has been a notable downward trend in the nominal corporate tax rates during 1980-2016 as the globalization has proceeded and the international tax competition between the nations has tighten. In 1980 the average nominal corporation tax rate was 48.6% (14 observations) with maximum of 61.5%, whereas in 2016 the average tax rate was 22.4% with 28 observations with highest rate of 35%. In 2016, the country with lowest tax rate is Ireland with 12.5% nominal tax rate.

The corporate tax rates used in the research are nominal after-interest rates. The tax rates include governmental corporate tax rates and possible sub-central corporate taxes. This assumption causes some noise to the data as the effective rate might differ, in some cases, significantly from the reported nominal tax rate. To provide context, Malta taxes companies at the standard rate of 35%. However, shareholders are entitled to a refund of part or of all the tax paid by the Malta company. Therefore, though corporate taxation in Malta is relatively high, the effective tax liability can decline to as low level as 5% of reported income (Malta Company Taxation, 2017). Also, there are possible changes on personal capital gains or wage, sometimes countries compensate the corporate tax rate changes by changing taxation of individuals. This is an issue which increases the noise in the sample.

Tax increases and decreases.

Despite the descendent trend of taxes, there are 45 tax increases inside the time period of 1980-2016 inside the EU area. Estonia, Malta, Czech Republic, UK and Slovenia didn't have any observations on tax increases. 17 of the tax increases were made after 2000, 28 in 1980-1999. Increases have become a bit less frequent this millennium, but otherwise increases are distributed quite equally. All the tax increases are listed in Appendix A. Over the period 1980-2016, I recorded 174 tax decreases inside the EU-area. Malta was the only country that didn't have any tax cuts. All the tax increases are listed in Appendix B.

3.3. Empirical strategy

I examine the sensitivity of European public firms' capital structure decisions from changes in member states' corporate taxes by using a difference-in-difference regression approach. The method is based on the earlier study made by Heider & Ljungqvist in 2012.

$$\Delta D_{ijct} = \beta \Delta T^{+}_{ct-1} + \gamma \Delta T^{-}_{ct-1} + \delta \Delta X_{it-1} + \theta \Delta Z_{ct-1} + \alpha_{jt-1} + \varepsilon_{ijct}$$

where *i* = index, *j* = firm, *c* = country *and t* = years. Δ is the first difference operator D_{ijct} is a measure of leverage. X_{it-1} and Z_{ct-1} are firm- and country-level control variables, $b\Delta T^{+}_{ct-1} + g\Delta T^{-}_{ct-1}$are the indicators if a country has increased or cut its tax rate and a_{jt-1}= estimates the industry fixed effects. The coefficients β and γ corresponds to the effect of tax changes on firms leverage. δ and θ capture the fixed effects for individual firms and country and α estimates the fixed effects to industry shocks.

Since the research is made by difference-in-difference approach, the regression compares the fixed effects of the countries that increase their tax rate to the control groups, which consist of all the firms with no corporate tax rate changes at the same year inside the EU28-area. The regression takes all available tax rate changes into account inside the period of 1980-2016. It also allows covariates that vary at the firm- or state-level and over time. To measure both, the effect of tax cut and increase, there are two tax variables with coefficient to differ the impact of tax cuts and rises. This enables to identify asymmetric tax sensitivity of tax changes.

For example, in 1985 there are two tax increases, one in Denmark, other in Greece and one tax decrease in United Kingdom. For those tax changes, I compare the affection of tax increases and tax cut to next year's leverage in Denmark, Greece and UK against all the other EU-countries with no changes in corporate tax rate.

4. **Empirical results**

4.1 Full sample

The results for all European public companies are listed in table 2. It shows how firms react to the corporate income tax changes annually on average by changing their long-term leverage in years t= -2 to t = +2 for the firms facing tax change at year t = 0 and for group of companies not experiencing tax changes in their home country. The table reports the change in leverage using fixed-effect linear model, which uses the OLS estimator to remove time invariant firm heterogeneity and includes the fixed effects for country, firm, industry and time to remove the effects of unobserved time-varying shocks.

I have two different estimates for the tax sensitivity of long-term leverage. First I make the regression using the actual changes corporate income tax rates, which captures the average change on leverage ratio for every one per cent change in tax rates. Additionally, I use dummy variables, which equal one in case of tax cut or tax rise and equal 0 if the firm do not face corporate tax change. Thus, the first estimate records the magnitude of every cut/increase whereas the second treats every tax change equally in the regression. The estimates measure different things as the dummy is aiming to identify whether the firms consider corporate taxation as first-order determinant while making the capital structure decisions and adapt the leverage level in line with it. The estimate which includes the volume of the change has much greater weight on big-scale tax changes, which is why I wanted to include both estimates to the research. It's hardly justified for example only to assume that the tax reduction of 25 percentage points in Austria 1989 to have same kind of effect on leverage like the reduction of 0.3% in Finland 1983.

Both of estimates produce significant results. Firms seem to respond to tax rate changes most drastically during the year of tax change and one year before. On average if a member state lowers its tax rate, the firms lower their leverage ratios by 0.22% (t-value of 2.57). The mean for long-term leverage in t = 0 is 12.24% and so the decrease on leverage is 1.83% from total long-term leverage. The decrease is even bigger in the prior year at -0.23% (t-value of 2.65), which is about 1.91% from average long-term leverage in year t = +1. There doesn't seem to be noteworthy reversal effect in the following years, indicating that the decrease in leverage is permanent. The estimates, which take the level of tax rate change produce also significant results and are quite in line with the dummy-estimations. The estimates from the regression with tax change volumes are more moderate compared to the dummy estimates. If a country changes its tax rate one per cent, it lowers the long-term leverage for mediocre firm by -0.02%. Although the estimates are slightly lower, they are additionally more precise and the significance level of the observations are about the same.

It's important to notice that the tax sensitivity of long-term debt seems to be asymmetric as the regression fails to identify any significant increases in leverage ratios in occasion of tax rise. Tax increases do not deliver any

results at the significance level of 0.05. To further investigate if there is any responsiveness to tax changes, I make conditional estimates to different groups.

4.2 Robustness test: financial distress

The trade-off theory suggests that corporations with significant bankruptcy costs should not respond to tax increases equally intensely as stable companies since the stressed companies have much higher marginal costs to increase debt. To test this prediction, I use Altman's Z-score as a proxy of distress costs. First I divide the sample into two groups; first group consists from the top quartile of Z-score values and the other from the bottom quarter of the observations (each group covers 21852 observations). After the partition, I examine, whether there are differences between the groups and their responsiveness to the tax raises using the same diff-in-diff method as earlier. The Z-score is a time-variable and it changes annually for the firm when there's data available. If any component of the Z-score is missing, the corporation is left out from the test.

The results are quite dull. The only result with any significance is the lagged after tax impact after tax increase. The firms with no distress seem to increase their long-term leverage by 0.2943%, but the result is significant at significance level of 0.1. The distressed firms do not respond to any changes.

4.3 Robustness test: multinational companies

Most European public companies are multinational. This research is based on the assumption of firms paying their taxes to their home country. If the firm has international business this might not be the case as the firm may home part of its income into other countries with lighter taxation. This signifies that firms with high domestic sales tend to respond more sensitively to the corporate tax change of their home country. The regression thus may underestimate the responsiveness of leverage to taxes.

The sensitivity of multinationals depends on, whether the firm have operations outside the home country and the location of their HQ. The more operations are distributed to other countries, the less precise the estimation of the regression is. To observe the affection of the sales locations, I examine the difference between firms with no sales internationally to firms with any foreign sales. The dummy is a time-variable and the possible multinationality of a corporation is observed annually so if a corporation expands its sales abroad, it will be considered in the regression in the same year.

The item for international sales in Datastream is quite limited and there are about 85740 observations with 21613 domestic observations and 64127 international observations. In table 3 are the results of the test and the estimates for tax cuts and decreases. The results are well in line with the hypothesis, as the difference-in-

difference estimates of tax sensitivity for domestic firms are highly significant. On average the firms with international sales doesn't seem to respond to increases at all, if anything the increases lower the leverage, these results are not significant though. In case of tax cut, neither group indicate any sensitivity.

4.4 Robustness test: dividends

Relatively high personal taxation on equity in respect to debt reduces the impact of tax benefit (DeAngelo, H. & Masulis, 1980). Dividends are observed because they are estimators for the equity taxation. Non-dividend payers have lower equity taxation than dividend-payers because their investors get equity income solely in the form of capital gains. The tax sensitivity of debt should thus be more notable for non-dividend payers. There seems to be no sensitivity in either groups. There are 56854 observations of non-dividend payers and 62348 observations of firms paying dividends.

In table 4 are listed the results between the two groups, first with no dividend payout and the second which pays out dividends. There are no significant results in either group. The reasons behind these zero results might be multifaceted. One reason can be that the non-dividend paying group is biased as large share of unprofitable firms do not pay out dividends. Other reasons can be that there are no substantial differences between equity and debt taxation (which is the case for example in Finland).

4.5 Robustness test: profitability

I also have two control groups consisting of profitable and loss-making companies. Without profits the interest tax shields do not have any value. This means that there should be no responsiveness inside the loss-making control group whereas profitable companies are anticipated to react according to the corporate tax changes. In total, there are 30988 observations of loss-making firms and 98677 observations of profitable companies. The outcome of this test can be found in table 4. The findings are in accordance with the assumption as profitable firms are highly sensitive to the tax cuts at the significance level of 0.01. There are also significant results in lagged and lead values.

4.6 Analysis on results

European Union has created a single market to ensure the free flow of goods, services and capital around the EU within the member states. This means that there are no significant barriers like tariffs for companies to operate in other countries. However, the countries are still responsible for their fiscal policy. This means that there are significant differences in corporate taxation. As majority of the public companies have remarkable international sales, the tax planning between sovereigns is possible.

When comparing the results with the American study, there are a couple of significant differences. The most obvious one is that the corporations in European Union responded asymmetrically only to tax cuts, whereas in American study the companies responded only to tax increases. Second difference concerns the timing of tax changes. In American study the tax rises had an impact on leverage in the following year. In this research the timing of the change on leverage varies from a year before the change to a year after.

In addition to the different results also the tax environment between U.S and European Union differs. The state tax rate constitutes just a small part of the total corporate taxation in the U.S as the statutory federal corporate tax rate is 35%. Few firms pay that much income tax, but even in effective basis state taxes are just 24% of total corporate taxes (U.S. Government Accountibility Office, 2013). In U.S., the tax planning between states is not so crucial as the changes in state tax do not change the effective tax rate very significantly. In Europe, the sovereigns have total control over the corporate taxation. Because of wider "tax scale" there are bigger benefits in tax planning inside EU-area than in U.S. where the federal tax creates the biggest part of taxation anyway.

In Europe, the free trade combined with independent tax policies in member states has created a platform for very concrete tax competition. Value driven public firms do acknowledge the impact of taxation to their cash flows and aim to home their income in countries with beneficial taxation. One reason for the asymmetric sensitivity of taxation may be caused by the possibility to move income from home country to other countries where the concern have sales in. Faccio and Xu (2015) prove that tax changes have decreasing effect on capital structure in countries with high use of tax evasion. By contrast, taxes matter progressively more as the evasion declines. The same findings are undoubtedly also applicable to other tax planning. In case of tax rise, firms might look for other options and rather try to avoid the increased tax obligations by transferring their taxable income to other countries (e.g. with group contributions and transfer pricing) than adapt their capital structure to the new optimal level. This theory is enforced by the fact that in case of tax rise the only groups to respond are firms with no international sales and with no financial distress. If there are no sales in foreign countries, there are no possibilities for tax planning. If EU home country lowers its corporate tax rate, it increases the after-tax profits and makes it more attractive to firms to home their income to home country and adjust their capital structure according to it. In further research, the relation between transfer pricing and capital structure decisions in home country would be an interesting issue to investigate.

Binsbergen & Al. have proved that that the cost of being overlevered is asymmetrically higher than the cost of being underlevered and that expected default costs constitute only half of the total ex ante costs of debt. Another possible reason for the opposite sensitivity can simply be that European firms tend to be more risk averse and are reluctant to increase the leverage along with taxes and the rises of leverage ratios are mainly made to finance new investments.

The timing of firms' capital structure transition varied from t = +1, 0, -1, when the tax change is timed at the start of t = 0. This is not unprecedented as to lower leverage ratios firms can use internal financing, issue new equity or cut back borrowing. Issuance of new equity costs firms the most as it has the biggest costs of asymmetric information. Loans from financial institutions are usually fixed and it is rarely possible to cut back borrowing suddenly without large costs, if the firm wants to lower its leverage. Firms can adapt to the tax changes step by step just by paying the debt capital and not issuing new debt. Because in many cases a long-term loan is permanent to be paid in many years or even decades, lowering leverage that way may take some time. The other low cost way to transform capital structure is to retain earnings from profits which increases the amount of equity. It is often difficult to change the actual payout ratio as it has negative impact on the market value of the firm even if the increased retained earnings would enlarge the equity and balances total capital in case of cutting down on leverage. These assumptions are in line with the aforementioned pecking order theory.

5. Conclusion

All European countries allow firms to deduct their interest payments from corporate income taxes. Although the theoretical basis of the tax shields has long been known there are little empirical evidence of European companies' responsiveness to corporate tax changes. This paper identifies that tax cuts have significant impact to firms' long-term leverage. The results are asymmetric as corporations do not respond to the corporate tax increases. The outcome from full sample is further observed by four different control groups to robust the findings.

The tax responsiveness of the firms is not in line with the hypothesis as the trade-off theory suggests the sensitivity to be symmetric between tax cuts and increases. There is no watertight theoretical explanation to this one-sided behavior, as firms are willing to decrease their leverage but not to increase borrowing when the value of debt changes.

One reason that could explain the unbalanced behavior, is the fragmentation of firms' operations across European territory as majority of public firms have sales in more than one country. The European countries decide independently on their fiscal policies which have created concrete tax competition. In case of tax rise it possible that firms try to avoid the increased liability by tax planning rather than adapting their capital structure. Another reason might be caused by the larger costs of overlevering compared to costs of underlevering. European companies might be risk averse in respect to tax increases and raise their leverage only to fund new investments.

One notable finding is that firms lowered their leverage in a few years. Lowering leverage is possible by cutting back borrowing, by issuing equity or by retaining earnings. Cutting back borrowing promptly may have big costs as the loan contracts are usually agreed to be fixed for a long time. Issuing new equity has also big costs to firm value and firms are usually reluctant to cut back dividend payout as it has a negative effect on their market value. Firms may lower their leverage over few years since the cheapest option to decrease leverage ratio is by retaining earnings and cutting back net borrowing along with fixed payment schedules.

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Appendix

Appendix A. List of member countries' corporate tax increases

This table lists all corporate tax increases over the years 1980-2016. The tax rates add up the nominal corporate tax by the central government with possible sub-central government corporate income tax rates used for example in Germany, Italy and Portugal. To identify these changes for tax rates I use data from OECD's database (http://stats.oecd.org) and from Trading Economics (http://www.tradingeconomics.com/).

Country	Year							No. of affected sample firms
Greece	2015	Increase of	3,0 %	from	26,0 %	to	29,0 %	321
Luxembourg	2013	Increase of	0,4 %	from	28,8 %	to	29,2 %	6
France	2013	Increase of	1,9 %	from	36,1 %	to	38,0 %	1105
Cyprus	2013	Increase of	2,5 %	from	10,0 %	to	12,5 %	68
Slovakia	2013	Increase of	4,0 %	from	19,0 %	to	23,0 %	17
Greece	2013	Increase of	6,0 %	from	20,0 %	to	26,0 %	321
Portugal	2012	Increase of	3,0 %	from	28,5 %	to	31,5 %	86
Luxembourg	2011	Increase of	0,2 %	from	28,6 %	to	28,8 %	6
France	2011	Increase of	1,7 %	from	34,4 %	to	36,1 %	1105
Portugal	2011	Increase of	2,0 %	from	26,5 %	to	28,5 %	86
Lithuania	2009	Increase of	5,0 %	from	15,0 %	to	20,0 %	28
Hungary	2007	Increase of	2,7 %	from	17,3 %	to	20,0 %	38
Hungary	2006	Increase of	1,3 %	from	16,0 %	to	17,3 %	38
Croatia	2003	Increase of	0,3 %	from	20,0 %	to	20,3 %	42
Germany	2003	Increase of	1,3 %	from	38,9 %	to	40,2 %	1021
Finland	2000	Increase of	1,0 %	from	28,0 %	to	29,0 %	185
Cyprus	2000	Increase of	4,0 %	from	25,0 %	to	29,0 %	68
Greece	1998	Increase of	5,0 %	from	35,0 %	to	40,0 %	321
Bulgaria	1997	Increase of	0,2 %	from	40,0 %	to	40,2 %	54
Germany	1997	Increase of	0,9 %	from	55,9 %	to	56,8 %	1021
France	1997	Increase of	5,0 %	from	36,7 %	to	41,7 %	1105
Germany	1996	Increase of	0,8 %	from	55,1 %	to	55,9 %	1021
Finland	1996	Increase of	3,0 %	from	25,0 %	to	28,0 %	185
Germany	1995	Increase of	2,9 %	from	52,2 %	to	55,1 %	1021
France	1995	Increase of	3,3 %	from	33,3 %	to	36,7 %	1105
Italy	1994	Increase of	1,0 %	from	52,2 %	to	53,2 %	365
Austria	1994	Increase of	4,0 %	from	30,0 %	to	34,0 %	112
Belgium	1993	Increase of	1,2 %	from	39,0 %	to	40,2 %	145
Germany	1992	Increase of	1,9 %	from	56,3 %	to	58,2 %	1021
Italy	1992	Increase of	4,4 %	from	47,8 %	to	52,2 %	365
Italy	1991	Increase of	1,4 %	from	46,4 %	to	47,8 %	365
Germany	1991	Increase of	1,7 %	from	54,5 %	to	56,3 %	1021
Finland	1989	Increase of	1,0 %	from	51,5 %	to	52,5 %	185
Sweden	1989	Increase of	3,5 %	from	56,6 %	to	60,1 %	577
Greece	1985	Increase of	4,0 %	from	45,0 %	to	49,0 %	321
Denmark	1985	Increase of	10,0 %	from	40,0 %	to	50,0 %	189
Finland	1984	Increase of	0,3 %	from	61,5 %	to	61,8 %	185
Spain	1984	Increase of	2,0 %	from	33,0 %	to	35,0 %	179
Sweden	1983	Increase of	0,3 %	from	57,8 %	to	58,1 %	577
Portugal	1983	Increase of	4,4 %	from	50,7 %	to	55,1 %	86
Italy	1983	Increase of	5,1 %	from	41,3 %	to	46,4 %	365
Finland	1982	Increase of	0,3 %	from	61,5 %	to	61,8 %	185
Portugal	1982	Increase of	1,8 %	from	49,0 %	to	50,7 %	86
Ireland	1982	Increase of	5,0 %	from	45,0 %	to	50,0 %	88
Italy	1982	Increase of	5,1 %	from	36,3 %	to	41,3 %	365

Appendix B. List of member countries' corporate tax decreases

This table lists all corporate tax cuts over the years 1980-2016. The tax rates add up the nominal corporate tax by the central government with possible sub-central government corporate income tax rates used for example in Germany, Italy and Portugal. To identify these changes for tax rates I use data from OECD's database (http://stats.oecd.org) and from Trading Economics (http://www.tradingeconomics.com/). There was one tax cut at the turn of the millennium, which differed between the two data sources. In case of contradiction, I used the data from OECD.

Country	Year					No. of affected sample firms
France	2016	Reduction of	-3,6 %	38,0 %	34,4 %	1105
Spain	2016	Reduction of	-3,0 %	28,0 %	25,0 %	179
Denmark	2016	Reduction of	-1,5 %	23,5 %	22,0 %	189
Spain	2015	Reduction of	-2,0 %	30,0 %	28,0 %	179
Denmark	2015	Reduction of	-1,0 %	24,5 %	23,5 %	189
Estonia	2015	Reduction of	-1,0 %	21,0 %	20,0 %	52
United Kingdom	2015	Reduction of	-1,0 %	21,0 %	20,0 %	3379
Portugal	2014	Reduction of	-2,0 %	31,5 %	29,5 %	86
Finland	2014	Reduction of	-4,5 %	24,5 %	20,0 %	185
United Kingdom	2014	Reduction of	-2,0 %	23,0 %	21,0 %	3379
Slovakia	2014	Reduction of	-1,0 %	23,0 %	22,0 %	17
Denmark	2014	Reduction of	-0,5 %	25,0 %	24,5 %	189
Sweden	2013	Reduction of	-4,3 %	26,3 %	22,0 %	577
Slovenia	2013	Reduction of	-3,0 %	20,0 %	17,0 %	18
United Kingdom	2013	Reduction of	-1,0 %	24,0 %	23,0 %	3379
United Kingdom	2012	Reduction of	-2,0 %	26,0 %	24,0 %	3379
Finland	2012	Reduction of	-1,5 %	26,0 %	24,5 %	185
Italy	2012	Reduction of	-0,1 %	31,4 %	31,3 %	365
Greece	2011	Reduction of	-4,0 %	24,0 %	20,0 %	321
United Kingdom	2011	Reduction of	-2,0 %	28,0 %	26,0 %	3379
Netherlands	2011	Reduction of	-0,5 %	25,5 %	25,0 %	261
Lithuania	2010	Reduction of	-5,0 %	20,0 %	15,0 %	28
Czech Republic	2010	Reduction of	-1,0 %	20,0 %	19,0 %	54
Greece	2010	Reduction of	-1,0 %	25,0 %	24,0 %	321
Hungary	2010	Reduction of	-1,0 %	20,0 %	19,0 %	38
Slovenia	2010	Reduction of	-1,0 %	21,0 %	20,0 %	18
Sweden	2009	Reduction of	-1,7 %	28,0 %	26,3 %	577
Luxembourg	2009	Reduction of	-1,0 %	29,6 %	28,6 %	6
Slovenia	2009	Reduction of	-1,0 %	22,0 %	21,0 %	18
Czech Republic	2009	Reduction of	-1,0 %	21,0 %	20,0 %	54
Germany	2008	Reduction of	-8,7 %	38,9 %	30,2 %	1021
Italy	2008	Reduction of	-5,9 %	37,3 %	31,4 %	365
Czech Republic	2008	Reduction of	-3,0 %	24,0 %	21,0 %	54
Spain	2008	Reduction of	-2,5 %	32,5 %	30,0 %	179
United Kingdom	2008	Reduction of	-2,0 %	30,0 %	28,0 %	3379
Estonia	2008	Reduction of	-1,0 %	22,0 %	21,0 %	52
Slovenia	2008	Reduction of	-1,0 %	23,0 %	22,0 %	18
Croatia	2008	Reduction of	-0,3 %	20,3 %	20,0 %	42
Bulgaria	2007	Reduction of	-5,0 %	15,0 %	10,0 %	54
Netherlands	2007	Reduction of	-4,1 %	29,6 %	25,5 %	261
Greece	2007	Reduction of	-4,0 %	29,0 %	25,0 %	321
Denmark	2007	Reduction of	-3,0 %	28,0 %	25,0 %	189
Spain	2007	Reduction of	-2,5 %	35,0 %	32,5 %	179
Slovenia	2007	Reduction of	-2,0 %	25,0 %	23,0 %	18
Estonia	2007	Reduction of	-1,0 %	23,0 %	22,0 %	52
Portugal	2007	Reduction of	-1,0 %	27,5 %	26,5 %	86
Greece	2006	Reduction of	-3,0 %	32,0 %	29,0 %	321
Czech Republic	2006	Reduction of	-2,0 %	26,0 %	24,0 %	54
Netherlands	2006	Reduction of	-1,9 %	31,5 %	29,6 %	261
Estonia	2006	Reduction of	-1,0 %	24,0 %	23,0 %	52
Luxembourg	2006	Reduction of	-0,8 %	30,4 %	29,6 %	6
France	2006	Reduction of	-0,5 %	35,0 %	34,4 %	1105
Austria	2005	Reduction of	-9,0 %	34,0 %	25,0 %	112
Romania	2005	Reduction of	-9,0 %	25,0 %	16,0 %	82
Cyprus	2005	Reduction of	-5,0 %	15,0 %	10,0 %	68
Bulgaria	2005	Reduction of	-4,5 %	19,5 %	15,0 %	54
Finland	2005	Reduction of	-3,0 %	29,0 %	26,0 %	185
Greece	2005	Reduction of	-3,0 %	35,0 %	32,0 %	321
Netherlands	2005	Reduction of	-3,0 %	34,5 %	31,5 %	261

Czech Republic	2005	Reduction of	-2,0 %	28,0 %	26,0 %	54
Estonia	2005	Reduction of	-2,0 %	26,0 %	24,0 %	52
Denmark	2005	Reduction of	-2,0 %	30,0 %	28,0 %	189
France	2005	Reduction of	-0,5 %	35,4 %	35,0 %	1105
Poland	2004	Reduction of	-8,0 %	27,0 %	19,0 %	401
Slovakia	2004	Reduction of	-6,0 %	25,0 %	19,0 %	17
Portugal	2004	Reduction of	-5,5 %	33,0 %	27,5 %	86
Bulgaria	2004	Reduction of	-4,0 %	23,5 %	19,5 %	54
Czech Republic	2004	Reduction of	-3,0 %	31,0 %	28,0 %	54
Hungary	2004	Reduction of	-2,0 %	18,0 %	16,0 %	38
Germany	2004	Reduction of	-1,3 %	40,2 %	38,9 %	1021
Italy	2004	Reduction of	-1,0 %	38,3 %	37,3 %	365
Cyprus	2003	Reduction of	-13,0 %	28,0 %	15,0 %	68
Belgium	2003	Reduction of	-6,2 %	40,2 %	34,0 %	145
Ireland	2003	Reduction of	-3,5 %	16,0 %	12,5 %	88
Italy	2003	Reduction of	-2,0 %	40,3 %	38,3 %	365
Poland	2003	Reduction of	-1,0 %	28,0 %	27,0 %	401
Latvia	2002	Reduction of	-10,0 %	25,0 %	15,0 %	25
Luxembourg	2002	Reduction of	-7,1 %	37,5 %	30,4 %	6
Bulgaria	2002	Reduction of	-4,5 %	28,0 %	23,5 %	54
Ireland	2002	Reduction of	-4,0 %	20,0 %	16,0 %	88
Slovakia	2002	Reduction of	-4,0 %	29,0 %	25,0 %	17
Greece	2002	Reduction of	-2,5 %	37,5 %	35,0 %	321
Portugal	2002	Reduction of	-2,2 %	35,2 %	33,0 %	86
France	2002	Reduction of	-1,0 %	36,4 %	35,4 %	1105
Netherlands	2002	Reduction of	-0,5 %	35,0 %	34,5 %	261
Germany	2002	Reduction of	0,0 %	38,9 %	38,9 %	1021
Germany	2001	Reduction of	-13,1 %	52,0 %	38,9 %	1021
Bulgaria	2001	Reduction of	-4,5 %	32,5 %	28,0 %	54
Ireland	2001	Reduction of	-4,0 %	24,0 %	20,0 %	88
Greece	2001	Reduction of	-2,5 %	40,0 %	37,5 %	321
Denmark	2001	Reduction of	-2,0 %	32,0 %	30,0 %	189
Poland	2001	Reduction of	-2,0 %	30,0 %	28,0 %	401
France	2001	Reduction of	-1,3 %	37,8 %	36,4 %	1105
Cyprus	2001	Reduction of	-1,0 %	29,0 %	28,0 %	68
Italy	2001	Reduction of	-1,0 %	41,3 %	40,3 %	365
Romania	2000	Reduction of	-13,0 %	38,0 %	25,0 %	82
Slovakia	2000	Reduction of	-11,0 %	40,0 %	29,0 %	17
Latvia	2000	Reduction of	-4,0 %	29,0 %	25,0 %	25
Ireland	2000	Reduction of	-4,0 %	28,0 %	24,0 %	88
Poland	2000	Reduction of	-4,0 %	34,0 %	30,0 %	401
Czech Republic	2000	Reduction of	-4,0 %	35,0 %	31,0 %	54
France	2000	Reduction of	-2,2 %	40,0 %	37,8 %	1105
Portugal	2000	Reduction of	-2,2 %	37,4 %	35,2 %	86
Bulgaria	2000	Reduction of	-1,8 %	34,3 %	32,5 %	54
Germany	1999	Reduction of	-4,0 %	56,0 %	52,0 %	1021
Ireland	1999	Reduction of	-4,0 %	32,0 %	28,0 %	88
Bulgaria	1999	Reduction of	-2,7 %	37,0 %	34,3 %	54
Denmark	1999	Reduction of	-2,0 %	34,0 %	32,0 %	189
Poland	1999	Reduction of	-2,0 %	36,0 %	34,0 %	401
France	1999	Reduction of	-1,7 %	41,7 %	40,0 %	1105
United Kingdom	1999	Reduction of	-1,0 %	31,0 %	30,0 %	3379
Italy	1998	Reduction of	-12,0 %	53,2 %	41,3 %	365
Czech Republic	1998	Reduction of	-4,0 %	39,0 %	35,0 %	54
Ireland	1998	Reduction of	-4,0 %	36,0 %	32,0 %	88
Bulgaria	1998	Reduction of	-3,2 %	40,2 %	37,0 %	54
Poland	1998	Reduction of	-2,0 %	38,0 %	36,0 %	401
Germany	1998	Reduction of	-0,8 %	56,8 %	56,0 %	1021
Portugal	1997	Reduction of	-2,2 %	39,6 %	37,4 %	86
Poland	1997	Reduction of	-2,0 %	40,0 %	38,0 %	401
United Kingdom	1997	Reduction of	-2,0 %	33,0 %	31,0 %	3379
Ireland	1996	Reduction of	-2,0 %	38,0 %	36,0 %	88
Czech Republic	1996	Reduction of	-2,0 %	41,0 %	39,0 %	54
Hungary	1995	Reduction of	-18,0 %	36,0 %	18,0 %	38
Ireland	1995	Reduction of	-2,0 %	40,0 %	38,0 %	88
Czech Republic	1995	Reduction of	-1,0 %	42,0 %	41,0 %	54
Slovakia	1994	Reduction of	-5,0 %	45,0 %	40,0 %	17
Germany	1994	Reduction of	-4,3 %	56,5 %	52,2 %	1021
Hungary	1994	Reduction of	-4,0 %	40,0 %	36,0 %	38
Czech Republic	1994	Reduction of	-3,0 %	45,0 %	42,0 %	54
Sweden	1994	Reduction of	-2,0 %	30,0 %	28,0 %	577
Finland	1993	Reduction of	-14,0 %	39,0 %	25,0 %	185
Greece	1993	Reduction of	-5,5 %	40,5 %	35,0 %	321
Germany	1993	Reduction of	-1,6 %	58,2 %	56,5 %	1021
France	1993	Reduction of	-0,7 %	34,0 %	33,3 %	1105

France	1992	Reduction of	-8,0 %	42,0 %	34,0 %	1105
Greece	1992	Reduction of	-5,5 %	46,0 %	40,5 %	321
Denmark	1992	Reduction of	-4,0 %	38,0 %	34,0 %	189
Finland	1992	Reduction of	-3,0 %	42,0 %	39,0 %	185
Sweden	1991	Reduction of	-23,0 %	53,0 %	30,0 %	577
Ireland	1991	Reduction of	-3,0 %	43,0 %	40,0 %	88
Finland	1991	Reduction of	-2,5 %	44,5 %	42,0 %	185
Denmark	1991	Reduction of	-2,0 %	40,0 %	38,0 %	189
Belgium	1991	Reduction of	-2,0 %	41,0 %	39,0 %	145
United Kingdom	1991	Reduction of	-1,0 %	34,0 %	33,0 %	3379
Portugal	1991	Reduction of	-0,5 %	40,2 %	39,6 %	86
Denmark	1990	Reduction of	-10,0 %	50,0 %	40,0 %	189
Hungary	1990	Reduction of	-10,0 %	50,0 %	40,0 %	38
Finland	1990	Reduction of	-8,0 %	52,5 %	44,5 %	185
Sweden	1990	Reduction of	-7,1 %	60,1 %	53,0 %	577
Germany	1990	Reduction of	-5,5 %	60,0 %	54,5 %	1021
Belgium	1990	Reduction of	-2,0 %	43,0 %	41,0 %	145
United Kingdom	1990	Reduction of	-1,0 %	35,0 %	34,0 %	3379
Austria	1989	Reduction of	-25,0 %	55,0 %	30,0 %	112
Portugal	1989	Reduction of	-7,9 %	48,1 %	40,2 %	86
Netherlands	1989	Reduction of	-7,0 %	42,0 %	35,0 %	261
Ireland	1989	Reduction of	-4,0 %	47,0 %	43,0 %	88
Greece	1989	Reduction of	-3,0 %	49,0 %	46,0 %	321
France	1988	Reduction of	-3,0 %	45,0 %	42,0 %	1105
Ireland	1988	Reduction of	-3,0 %	50,0 %	47,0 %	88
Portugal	1987	Reduction of	-2,2 %	50,3 %	48,1 %	86
Belgium	1987	Reduction of	-2,0 %	45,0 %	43,0 %	145
Finland	1986	Reduction of	-10,3 %	61,8 %	51,5 %	185
United Kingdom	1986	Reduction of	-5,0 %	40,0 %	35,0 %	3379
France	1986	Reduction of	-5,0 %	50,0 %	45,0 %	1105
Portugal	1986	Reduction of	-4,8 %	55,1 %	50,3 %	86
Netherlands	1986	Reduction of	-1,0 %	43,0 %	42,0 %	261
United Kingdom	1985	Reduction of	-5,0 %	45,0 %	40,0 %	3379
Netherlands	1984	Reduction of	-5,0 %	48,0 %	43,0 %	261
United Kingdom	1984	Reduction of	-5,0 %	50,0 %	45,0 %	3379
Sweden	1984	Reduction of	-1,5 %	58,1 %	56,6 %	577
Belgium	1983	Reduction of	-3,0 %	48,0 %	45,0 %	145
United Kingdom	1983	Reduction of	-2,0 %	52,0 %	50,0 %	3379
Finland	1983	Reduction of	-0,3 %	61,8 %	61,5 %	185

*Latvia's change of corporate tax rate was 4 percentage point according to OECD, Trading Economics recorded a change of 5 percentage points.

Appendix C. List of Datastream items used in the research

Time variables

Dependant Variables

- Total Liabilities (WS) WC03351
- Long-term book leverage (WC03251)

Control variables (Datastream item)

- Net Tangible Assets (NTA)
- Price-to-Book Value (PTBV)
- Return on Assets (WC08326)
- Total Assets (U.s.$) (WC07230)
- Total Assets (WC02999)
- Dividend Payout % Earnings (WC08256)
- International Sales (WC07101)

Variables used for Altman's Z-score

- Earnings Before Interest and Taxes (WC18191)
- Retained Earnings (WC03495)
- Working Capital (WC03151)
- Total Assets (WS) (Key item) WC02999
- Market Value (MSMV)
- Net Sales or Revenues WC01001

Static Variables

- Industry Identifier: Sic Code (WC07021)
- Country of Security (IBCTRY)
- Code of Security - Datastream (DSCD)

Figure 1. The theoretical basis for trade-off theory and empirical identification

The first figure visualizes the standard argument of trade-off theory. Companies should increase their leverage until the marginal cost of financial distress equals the marginal benefit of interest tax shield. The value of interest tax shields depends on the corporate tax rate (T_c), personal tax rate on income from debt (T_i), the personal tax rate on income from equity (T_e) and the amount of debt. The tax benefit for the firm equals $[(1-T_i)-(1-T_c)(1-T_e)]*D$. Financial distress costs grow by the formula $a + bD + cD^2$. Figures 1b, 1c and 1d illustrate the challenges of empirical identification of marginal cost and marginal benefit. In ideal situation (1b), the marginal cost and benefit are known. Different tax rates (MB1 , MB2 , MB3 ,… , MBn) are randomly assigned to firms and the resulting debt choices (D1 , D2 , D3 ,… , Dn) are recorded. The random assignment ensures that differences in debt levels cannot be the result of unobserved heterogeneity across firms. Figure 1c visualize the assumptions made for observational data. When comparing two firms which have different effective tax rates they must share the same marginal cost $MC_i = MC_j$. The identification challenge (visualized in 1d) is that companies can have different debt levels even without marginal benefits as long as they have different marginal costs which violates the identifying assumption (Heider & Ljungqvist 2012).

Figure 1a: Traditional view of trade of theory

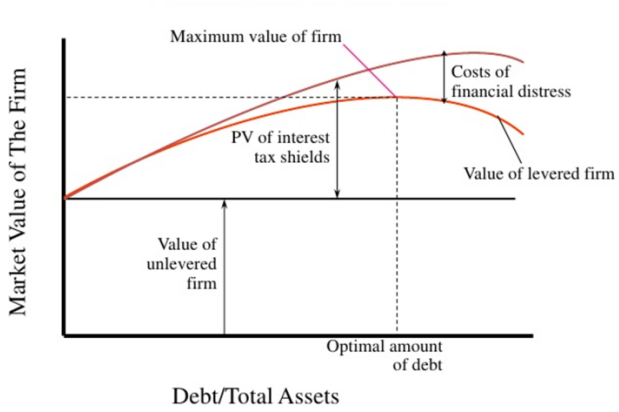

Figure 1b: The ideal experiment

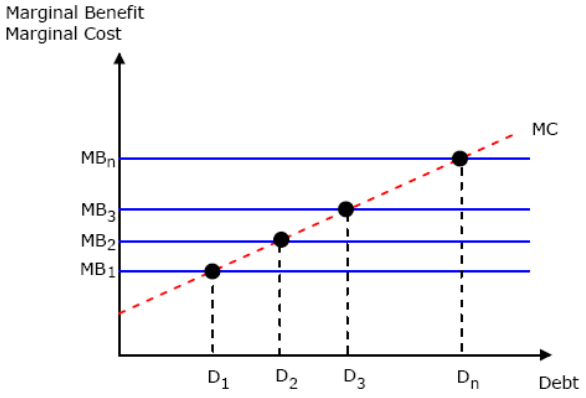

Figure 1c Identifiying assumption

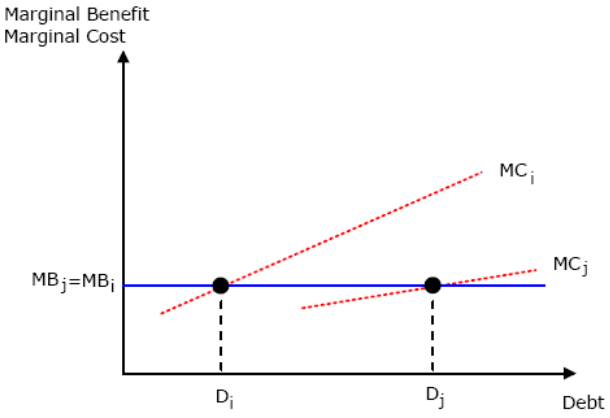

Figure 1d : Identification challenge

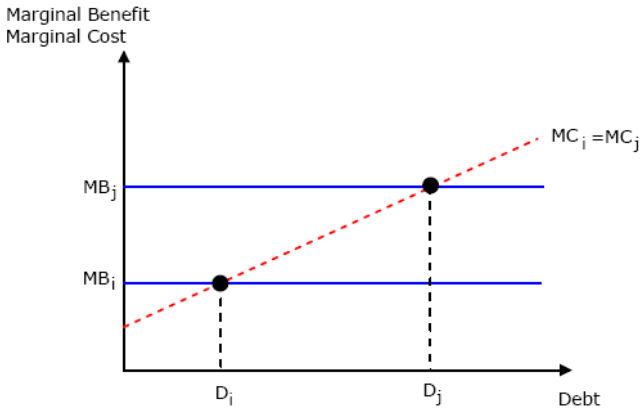

Table 1. Summary statistics

The sample consists of 424427 firm-years inside European Union area. All financials, utilities and public sector companies are omitted from the final sample. The summary table reports the statistics for all the dependent and control variables used in the research. The 0.5% of top and bottom observations are cut out from return on assets, total assets, net tangible assets, price-to-book ratio and Z-score.

	All firm-years (N = 424427)					
				Quartiles		
	Observations	mean	s.d.	1st Qu.	Median	3rd Qu.
Firm Leverage						
Long-term debt / Total assets	138649	12.24	14.57179	0.41	7.49	18.75
Total Liabilities / Total assets	135153	53.14	24.25735	38.48	55.38	69.52
Long-term debt ($)	141385	347500	2273517	156	6394	59100
Country-Specific Characteristics						
GDP-growth	368537	1.83	2.386259	0.800	2.00	3.00
Unemployment	337870	8.38	3.271422	6.10	8.10	10.00
Firm-specific factors						
Return on assets	127194	2.79	16.19313	0.48	4.54	8.47
Total Assets ($)	140707	2557000	39050429	25510	572900	4949000000
Net tangible assets ($)	217086	438100	3025304	9843	39390	158500
Price-to-book ratio	181734	2.4	4.55	0.75	1.48	2.74
Z-score	87407	0.90	3.27	0.70	1.50	2.30

Table 2. Effect of tax change on leverage

I estimate standard regression to test the sensitivity of the leverage in response to changes. The sample excludes all the financials, public-sector entities and utilities. All firms with negative equity are deleted from the regression as they are in serious distress. The results in the first columns are mainly positive because they are estimated with the positive (tax rise) and negative (tax cut) coefficients. In the second columns, the dummy variable is valued at 1 in case of tax change and otherwise 0. The unit of analysis is a firm-year.

	Depending variable: Change in long-term book leverage					
	Change in tax: -1/+1% (1)			Dummy: 1 if tax cut or rise (2)		
	Estimate	Std. error		Estimate	Std. error	
Tax cuts						
Tax cut in t = -2	0.003658	0.008264		0.05826	0.09983	
Tax cut in t = -1	0.010800	0.007902		-0.005254	0.092934	
Tax cut in t = 0	0.020052	0.007479	**	-0.224047	0.087181	**
Tax cut in t = +1	0.015073	0.007993	.	-0.232892	0.088045	**
Tax cut in t = +2	0.002108	0.002121		-0.021789	0.024517	
Tax rises						
Tax rise in t = -2	0.007474	0.083900		-0.147661	0.239044	
Tax rise in t = -1	0.0318771	0.0783780		-0.3410792	0.2263581	
Tax rise in t = 0	-0.066467	0.074527		-0.362832	0.212051	
Tax rise in t = +1	-0.059271	0.075624		0.021309	0.215844	
Tax rise in t = +2	0.044985	0.078186		0.185216	0.223441	
Control variables at t = 0						
ROA	-0.2332341	0.1036613	*	-0.247311	0.101537	*
Firm size	5.1087111	0.0740003	***	5.030415	0.072534	***
Tangibility	-1.6513824	0.0257731	***	-1.599082	0.025038	***
PBV	0.1646449	0.0090500	***	0.159895	0.008945	***
Default spread	-0.2766011	0.0226986	***	-0.274647	0.022488	***
GDP Growth	-0.1375639	0.0229293	***	-0.135817	0.022381	***
Unemployment	-0.0573793	0.0185048	**	-0.048298	0.016953	**
Diagnostics						
Full model R^2	0.63			0.64		
Observations	52916			52916		
Significance codes	*** = 0.001, ** = 0.01, * = 0.05, . = 0.1					

Table 3. Financial distress and location of sales

Firms with financial distress have higher margin costs to increase leverage compared to stable firms. In the first column is the quartile of observations with highest Z-scores and in the second column there's the quartile with lowest Z-scores. The sample is winsorized 0.5% from each tail. In third and fourth columns, I compare the observations with international sales to observations without international sales. If the international sales value is 0 the dummy is also 0 otherwise, it is 1. The unit of analysis is a firm-year.

Depending variable: Change in long-term book leverage								
	No financial distress (top quartile)		Financial distress (bottom quartile)		No international sales		International sales	
	(1)		(2)		(3)		(4)	
Change of 1% in tax increase at t= -1 in (%)	2.943e-01	.	0.3197680		2.916e-01	.	2.364e-02	
	1.625e-01		0.2593030		1.656e-01		1.095e-01	
Change of -1% in tax cut at t= -1 in (%)	0.0012405		0.0017952		5.086e-03	**	-2.483e.04	
	0.0025023		0.003398		1.926e-03		9.426e-04	
Change of 1% in tax increase at t= 0 in (%)	0.1097445		0.2580814		-1.568e-01		7.241e-02	
	0.1366905		0.2417122		2.268e-01		7.968e-02	
Change of -1% in tax cut at t= 0 in (%)	0.0005634		0.001828		6.489e-03	***	0.0032927	**
	0.0022311		0.002954		1.720e-03		0.0011642	
Change of 1% in tax increase at t= +1 in (%)	0.0810343		-0.901111		0.125382		5.558e-02	
	0.1524385		0.761329		0.507853		8.153e-02	
Change of -1% in tax cut at t= +1 in (%)	0.0003442		0.001098		0.003137	.	0.0013219	
	0.0024890		0.002932		0.001684		0.0008857	
Control variables at t = 0								
Return on assets	-0.0618120	***	-0.0110369		-1.192e+00	***	-4.499e-02	***
	0.0090005		0.0083338		2.384e-01		6.502e-03	
Firm size	4.5412776	***	3.1973931	***	2.625e+00	***	4.660355	***
	0.1685278		0.2523094		1.494e-01		0.142251	
Tangibilty	-2.0785855	***	-1.2396252	***	-1.102e-06	***	-1.249	***
	0.0699037		0.0641765		2.634e-07		2.7021e-01	
Price to book	0.0009717		0.0007129		3.902e-02	*	0.194758	***
	0.0008147		0.0017278		1.858e-02		0.017921	
Default risk	-0.5474039	***	0.0073448		6.416e-04		-0.605671	***
	0.0872146		0.0099915		7.477e-03		0.069437	
GDP growth	0.0117174		-0.0527393		-7.124e-02		-4.7121e-02	
	0.0473576		0.0984243		7.091e-02		4.8571e-02	
Unemployment	0.0678855	.	-0.2028537	**	-1.913e-02		-9.025e-03	
	0.0373766		0.0739189		5.426e-02		3.2576e-02	
Diagnostics								
Full model R²	0.66		0.64		0.73		0.64	
Observations	12598		8470		6143		27287	
Firms	1349		990		638		2885	
Significance codes	*** = 0.001, ** = 0.01, * = 0.05 , = 0.1							

Table 4. Profitability and dividend payout

High taxation on equity income reduces the effect of corporate taxation on leverage. To test it, I have dummy to separate firms with dividends from non-dividend payers. Non-dividend payers should have lower taxation on equity because their equity income is solely distributed in the form of capital gains. The observed tax response should thus vary with profits. Columns 3 and 4 shows the effect of profitability to income and divide the sample firms according to whether they are profitable or loss-making in year 0. Without profits to shield, there are no tax benefit of debt. The unit of analysis is a firm-year.

Depending variable: Change in long-term book leverage								
	Non-dividend payers		Dividend payers		Profitable		Loss-making	
	(1)		(2)		(3)		(4)	
Change of 1% in tax increase at t= -1 in (%)	-0.076257		-5.205e-02		2.338e-02		9.037e-02	
	0.156160		1.053e-01		8.279e-02		2.381e-01	
Change of -1% in tax cut at t= -1 in (%)	0.0002976		4.709e-04		1.161e-03	.	3.333e-03	
	0.0021563		7.958e-04		7.346e-04		4.975e-03	
Change of 1% in tax increase at t= 0 in (%)	-0.072076		-0.37887		-0.139597	.	0.0840119	
	0.147834		0.24927		0.076917		0.2117488	
Change of -1% in tax cut at t= 0 in (%)	0.001515		0.0013226		0.0021264	**	5.329e-03	
	0.001930		0.0007188		0.0006798		4.533e-03	
Change of 1% in tax increase at t= +1 in (%)	0.001123		-0.123948		-0.046807		-0.295019	
	0.001957		0.102479		0.082610		0.202442	
Change of -1% in tax cut at t= +1 in (%)	-0.297431		0.0003157		1.844e-03	*	2.925e-03	
	0.147681		0.0007702		7.441e-04		4.332e-03	
Control variables at t = 0								
Return on assets	-0.009847	*	8.155275		-0.1071676	**	-0.0009223	
	0.004614		7.278978		0.0068974		0.0086008	
Firm size	4.228332	***	7.05956	***	6.4434753	***	3.1674262	***
	0.163029		0.14158		0.0883096		0.2257904	
Tangibilty	-1.401145	***	-3.15700	***	-2.4122715	***	-1.1990376	***
	0.047152		0.06661		0.0374028		0.0591877	
Price to book	0.169673	*	0.29632	***	0.2224731		0.1242027	***
	0.017484		0.01993		0.0123259		0.0221504	
Default spread	-0.136162	**	-2.69455	***	-0.9285927	***	-0.1590969	**
	0.049361		0.12982		0.0563167		0.0617174	
GDP growth	-0.132872	**	-0.03655	***	-0.2003392	***	-0.0593336	
	0.046569		0.03666		0.0242384		0.0726078	
Unemployment	0.022508		0.00762	**	-0.0323339	.	0.0264593	
	0.039478		0.02704		0.0190081		0.0613989	
Diagnostics								
Full model R^2	0.63		0.72		0.68		0.65	
Observations	20845		26537		49160		13865	
Firms	2723		2843		4244		1789	
Significance codes	*** = 0.001, ** = 0.01, * = 0.05, . = 0.1							